Purpose: X-ray scatter has been identified as a principal factor in cone-beam CT (CBCT) image quality in applications ranging from dental to IGRT and image-guided surgery. The variety of system geometries entail disparate scatter magnitudes, which bear heavily on the question of utility of antiscatter grids. This paper revisits this question for low-dose CBCT on a mobile C-arm for image-guided surgery, identifying tradeoffs in dose and image quality and answering the question of when (or whether) grids should be employed.

Methods: Studies were performed on a mobile C-arm prototype equipped with a flat-panel detector for high-quality CBCT. Antiscatter grids of grid ratio (GR) 6:1 – 12:1 (103 lpi) were tested under varying scatter conditions in “body” surgery (e.g., spine) using task-specific protocols for bone and soft tissue visibility in the thorax and abdomen. Studies included grid orientation, CT number accuracy, uniformity, contrast, noise, and contrast-to-noise ratio (CNR), each evaluated in quantitative / anthropomorphic phantoms.

Results: Grid orientation along the detector z-axis introduced susceptibility to artifacts attributed to ramp filter amplification of gridlines under motion nonidealities. Orientation along the xy-axis resolved this effect. Increasing GR improved CT number accuracy from 40% error (no grid) to 4% (12:1), but imparted an increase in noise by ~20-60%. CNR for high-contrast objects was largely unaffected by grids, but a significant reduction (2-44%) in CNR was observed in low-contrast soft-tissues.

Conclusion: While grids showed substantial improvement in CT number accuracy and uniformity, soft-tissue CNR was reduced due to grid attenuation in both the thorax and abdomen. The CNR could be restored by increasing the dose by a factor of 1.5. This poses a significant drawback to low-dose, repeat CBCT and diminishes the extent to which grids should be employed, particularly in light of simple scatter correction techniques that offer comparable restoration without increase in dose.

Funding Support, Disclosures, and Conflict of Interest:

Research supported by the National Institutes of Health R01-CA-127444 and collaboration with Siemens Healthcare (Erlangen Germany).